A Multipurpose Fruit and Vegetable Processing System for Advanced Life Support

Completed Technology Project (2003 - 2007)

Project Introduction

The following tasks were identified in the proposal: 1) Year 1 (January 1, 2003-December 31, 2003): a. Select varieties of tomatoes and other vegetables suitable for processing; b. Develop conceptual design for the Multipurpose Fruit and Vegetable Processor (MFVP); c. Develop computer-aided simulations of each operation to assist in design; d. Build bench-scale components of the MFVP and conduct preliminary trials for technical feasibility; e. Select optimum design parameters; f. Select membranes for water cleaning and product recovery. 2) Year 2 (January 1, 2004 – December 31, 2004) a. Construct MFVP from components; b. Select membrane systems for concentration of tomato juice; c. Conduct trials with MFVP to determine operational feasibility; d. Determine equivalent system mass (ESM) and other operational variables; e. Conduct optimization trials. 3) Year 3 (January 1, 2005 – December 31, 2005) a. Conduct experimental trials to determine safety, quality, and acceptability of foods processed in MFVP; b. Develop final modifications as indicated from the experimental data; c. Write final project report. To develop a miniaturized fruit and vegetable processor and to evaluate and optimize its performance for Advanced Life Support (ALS). The development of the fruit and vegetable processor represents the first attempt to miniaturize and integrate the array of unit operations required for preparation and processing of fruits and vegetables such as tomato. Additionally, the developers integrate the ESM metric evaluation throughout the development process as the primary project management tool.

Anticipated Benefits

The research data on concentrating tomato juice using new generation membranes is valuable for the food industry. Only one Japanese company is currently employing this technique in a food plant located in California. Our data should prove useful for those food processors who are seeking optimization of the process.

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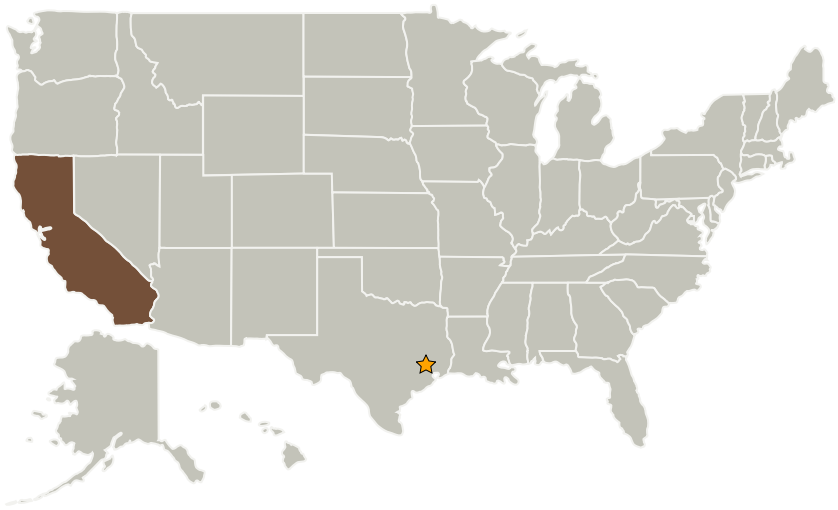
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
University of California-Davis(UC Davis)	Supporting Organization	Academia	Davis, California

Primary U.S. Work Locations
California

Project Transitions

January 2003: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Operations Mission Directorate (SOMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Human Spaceflight Capabilities

Project Management

Program Director:

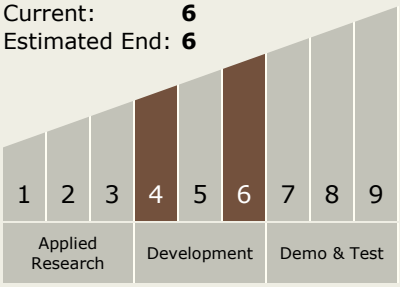
David K Baumann

Principal Investigator:

R P Singh

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

Continued on following page.

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Completed Technology Project (2003 - 2007)

January 2007: Closed out

Closeout Summary: During the one-year no-cost extension, we completed the fabrication of the multipurpose fruit and vegetable food processor (MFVP) and th e remaining trials with its components. In addition, we conducted a comprehensi ve study to obtain data on using electrolyzed water for cleaning-in-place (CIP) o f the MFVP. CIP with electrolyzed water is an attractive option for cleaning as it does not require detergents (caustic solution) or disinfectants (chlorine). Theref ore it could be more suitable for application in a controlled environment system. Electrolyzed water is generated from salt mixed in water. We conducted trials wi th a stainless steel test-bed containing various components used in the MFVP. T he cleaning and disinfection of the components after inoculation was validated w ith microbial testing. Specifically, the effectiveness of electrolyzed oxidizing wate r (EOW) and electrolyzed reducing water (ERW) used in clean-in-place (CIP) app lications for MFVP were studied using 38 mm (1.5 in) diameter stainless steel (S S316L) pipes fouled with apple juice. Data were compared with industrial CIP cle aner (chlorinated NaOH) and antimicrobial solution (mixture of peroxyacetic acid and hydrogen peroxide). Cleanliness of stainless steel (SS) pipe surfaces was qu antified by a hygiene monitoring test and aerobic plate count. Data were obtaine d to determine the removal of organic debris and microorganisms at 5, 10, 15, a nd 20 min washing using electrolyzed water and industrial cleaning chemicals. El ectrolyzed water showed potential use in CIP applications--it is easy to use and l ess hazardous compared to the industrial cleaning chemicals. Microbiological eva luation showed 5 min cleaning with EOW followed by 5 min cleaning with ERW w as sufficient to drop cell levels from 5.2±0.3 log CFU (colony forming units)/stai nless steel chip to below the limit of detection (<0.69 log CFU/cm2). In contras t, in case of bioluminescence tests, there were detectable adenosine triphosphat e (ATP) even after 15 min of cleaning, even though the system was microbiologi cally at below detection. Furthermore, bioluminescence tests revealed that indus trial cleaning chemicals were faster in cleaning compared to electrolyzed water. Electrolyzed water needs to be circulated more than 20 min at 0.6 m/s (2 ft/s) fl ow velocity to achieve acceptable cleaning, whereas industrial cleaning takes onl y 5 min of circulation for acceptable cleaning based on the bioluminescence read ings.

Stories

Articles in Peer-reviewed Journals
(https://techport.nasa.gov/file/25036)

Articles in Peer-reviewed Journals
(https://techport.nasa.gov/file/8935)

Project Website:

https://taskbook.nasaprs.com

Technology Areas *(cont.)*

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.3 Human Health and Performance
    - TX06.3.5 Food Production, Processing, and Preservation

Target Destinations

The Moon, Mars